CLAIMS

1. A boundary acoustic wave device using a non-leaky propagation type boundary acoustic wave, comprising boundary acoustic wave elements which are formed using a single crystal substrate having the same cut angle,

wherein the boundary acoustic wave elements each include the single crystal substrate, a solid layer provided thereon, and electrodes proved at a boundary between the single crystal substrate and the solid layer, and

of the boundary acoustic wave elements, the propagation direction of a boundary acoustic wave of at least one of the boundary acoustic wave elements is different from that of at least one of the other boundary acoustic wave elements.

2. The boundary acoustic wave device according to Claim 1, wherein the boundary acoustic wave elements are boundary acoustic wave filters or boundary acoustic wave resonators.

3. The boundary acoustic wave device according to Claim 1 or 2, wherein the boundary acoustic wave elements have a resonator structure.

4. The boundary acoustic wave device according to Claim 1, wherein the boundary acoustic wave device is a longitudinally coupled filter.

5. The boundary acoustic wave device according to one of Claims 1 to 4, wherein the boundary acoustic wave elements are provided on one piezoelectric single crystal substrate.

6. The boundary acoustic wave device according to one of Claims 1 to 5, wherein an electromechanical coefficient of at least one of the boundary acoustic wave elements is different from that of at least one of the other boundary acoustic wave elements.

7. The boundary acoustic wave device according to one of Claims 1 to 6, wherein the band width of at least one of the boundary acoustic wave elements is different from that of at least one of the other boundary acoustic wave elements.

8. The boundary acoustic wave device according to one of Claims 1 to 7, wherein the thickness of the electrodes is set so that the acoustic velocity of an SH type boundary acoustic wave is lower than the acoustic velocity of a slow transverse wave propagating through the solid layer and the acoustic velocity of a slow transverse wave propagating through the piezoelectric single crystal substrate.

9. The boundary acoustic wave device according to one of Claims 1 to 8, wherein the duty ratio of the electrodes is set

so that the acoustic velocity of an SH type boundary acoustic wave is lower than the acoustic velocity of a slow transverse wave propagating through the solid layer and the acoustic velocity of a slow transverse wave propagating through the piezoelectric single crystal substrate.

10. The boundary acoustic wave device according to one of Claims 1 to 9, wherein, when the density of the electrodes, the thickness of the electrodes, and the wavelength of a boundary wave are represented by ρ (kg/m^3), H (λ), and λ, respectively, $H>8261.744\rho^{-1.376}$ is satisfied.

11. The boundary acoustic wave device according to Claim 10, wherein $\rho>3,745$ kg/m^3 is satisfied.

12. The boundary acoustic wave device according to Claim 10 or 11, wherein $33,000.39050\rho^{-1.50232}<H<88,818.90913\rho^{-1.54998}$ is satisfied.

13. The boundary acoustic wave device according to one of Claims 1 to 12, wherein the piezoelectric single crystal substrate is a $LiNbO_3$ substrate, ϕ of Euler angles (ϕ, θ, ψ) of the $LiNbO_3$ substrate is in the range of -31° to 31°, and θ and ψ are in the range surrounded by points A1 to A13 shown in the following Table 1.

[Table 1]

Points	ψ (°)	θ (°)
A01	0	116
A02	11	118
A03	20	123
A04	25	127
A05	33	140
A06	60	140
A07	65	132
A08	54	112
A09	48	90
A10	43	87
A11	24	90
A12	0	91
A13	0	116

14. The boundary acoustic wave device according to one of Claims 1 to 13, wherein the electrodes each comprise a main electrode layer formed from one material selected from the group consisting of Au, Ag, Cu, Al, Fe, Ni, W, Ta, Pt, Mo, Cr, Ti, ZnO, and ITO.

15. The boundary acoustic wave device according to Claim 14, wherein the electrodes each further comprise a second electrode layer laminated on the main electrode layer.

16. The boundary acoustic wave device according to one of Claims 1 to 15, wherein the solid layer comprises a dielectric substance.

17. The boundary acoustic wave device according to Claim 16,

wherein the solid layer comprises a material primarily composed of SiO_2.

18. The boundary acoustic wave device according to one of Claims 1 to 16, wherein the solid layer is formed of a plurality of laminates which are each formed by laminating a plurality of material layers.

19. The boundary acoustic wave device according to Claim 18, wherein the solid layer has the structure in which a layer primarily composed of SiO_2 is laminated to a layer primarily composed of Si.

20. The boundary acoustic wave device according to one of Claims 1 to 16, wherein the solid layer is formed of at least one material selected from the group consisting of Si, SiO_2, glass, silicon nitride, silicon carbide, ZnO, Ta_2O_5, titanate zirconate lead piezoelectric ceramic, aluminum nitride, Al_2O_3, $LiTaO_3$, and $LiNbO_3$.

21. The boundary acoustic wave device according to one of Claims 1 to 20, wherein the boundary acoustic wave elements each further include a resin layer formed on the solid layer so as to be adhered thereto.